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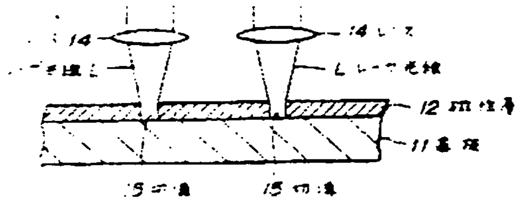

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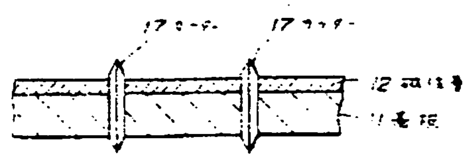


TITLE : CUTTING METHOD OF MAGNETIC RECORDING MEDIUM

ABSTRACT : PURPOSE: To obtain a magnetic recording medium which excels in the magnetic characteristics and reliability by cutting a magnetic layer into a prescribed form with irradiation of a laser beam and then cutting the magnetic recording medium by a cutter in accordance with said prescribed form.

CONSTITUTION: A laser beam L is absorbed by a magnetic layer 12 with high efficiency since the magnetic material of the layer 12 is colored. While the beam L passes through a substrate 11 which dose not absorb the beam L. therefore when the beam L is irradiated on the substrate 11 containing the layer 12, only the irradiated areas of the layer 12 are heated instantaneously up to a high temperature and evaporated. Thus a cutting groove 15 is formed. Then the layer 12 is cut along the groove 15 by a metallic cutter 17 and at the same time the width of a magnetic recording medium is controlled to the prescribed value. Thus the magnetic recording medium cut in such a way has no cracks produced to the layer 12 and has the smooth cut ends.

Japanese Patent Laid-Open Number: 61-180932/1986

[Prior Art]

Incidentally, in the cutting process, the coated magnetic recording medium, the magnetic powder thereof tending toward being made harder and being filled at a higher density, caused problems in that the cutter was considerably abraded by the harder magnetic powder, the abraded cutter was forced to apply an unreasonable force to the magnetic layer to distort it, the distorted magnetic layer caused cracks at the cut end thereof and dropping out of the magnetic powder occurred making the cut end being rugged, and this resulted in providing the magnetic recording medium with deteriorated magnetic characteristics together with poor reliability.

Furthermore, the above problems were noticeable also in the deposited magnetic recording medium. The magnetic layer thereof, being formed especially with only a hard metal thin magnetic film, caused the problem that it considerably abraded the cutter resulting in dropping off of the magnetic thin film.

[Problems to be Solved by the Invention]

As described above, the conventional method of cutting the magnetic recording medium caused problems in that cracks were caused at the cut end which was made rugged to provide the magnetic recording medium with poor magnetic characteristics and reliability.

The present invention is therefore intended to solve such problems with an object of providing a method of cutting a magnetic recording medium which causes no crack in the magnetic layer and can cut the medium so that the cut end becomes smooth to thereby provide the magnetic recording medium with excellent magnetic characteristics and reliability.

[Example]

A specific example of the method of cutting the magnetic recording medium to which method the present invention is applied will be explained in detail below in accordance with the sequence of the steps shown in Fig. 2 to Fig.4.

First, as shown in Fig. 2, a magnetic layer is formed on a substrate 11 comprising a non-magnetic material such as polyethylene terephtalate.

The magnetic material of the magnetic layer 12 and the forming method thereof may be any of a method of coating a powder of ferromagnetic oxide such as $\gamma - Fe_2O_3$, or a ferromagnetic metal powder of a metal such as Fe, Co or an alloy such as Fe – Co ferromagnetic metal oxide using a resin binder such as vinyl chloride, or a method of directly cladding the substrate 11 with a ferromagnetic metallic material of a metal such as Fe, Co, or Ni, or a Co – Ni alloy by a vacuum thin film forming technique such as vacuum deposition or sputtering.

Next to this, as shown in Fig. 3, the substrate 11 having the magnetic layer 12 being formed is irradiated from the side

of the magnetic layer 12 with laser beams L at a prescribed spacing for only the magnetic layer 12 to be cut off.

The laser beams L are radiated from an unillustrated laser oscillation apparatus, passed through optical systems comprising prisms and mirrors and converged by focusing lenses 14 for irradiation. The used oscillation source of the laser beams L is a high powered one such as a CO_2 gas laser, an argon gas laser, or a YAG laser (a crystal of yttrium-aluminum-garnet). The laser beam is used with its diameter narrowed to, for example, 100μm.

The laser beam L, because of the magnetic material forming the magnetic layer 12 being a colored material, is efficiently absorbed in the magnetic layer 12, while the substrate 11 which does not absorb the laser beam L with such a wave length allows the laser beam to transmit through it.

Thus, irradiation of the substrate 11, having the magnetic layer 12 formed thereon, with the laser beam L causes only the magnetic layer 12 at the irradiated portion to be instantaneously heated to an elevated temperature and vaporized, whereby a cut groove 15 is formed for the magnetic layer 12 to be cut off.

Incidentally, in order to prevent the magnetic characteristics of the magnetic layer 12 from being adversely affected by the rapid heating of the magnetic layer 12 due to the irradiation with the laser beam L, it is preferable to cut

the magnetic layer 12 with an inert gas blown at the point of the laser beam irradiation.

Moreover, the heat produced by the irradiation with the laser beam L is dissipated through the well heat conductive magnetic layer 12, so that the produced heat has no adverse effect on the substrate 11 such as deformation thereof.

Finally, as shown in Fig.4, the substrate 11 is cut off along the cut grooves 15 by cutters 17 made of a material such as metal, with the dimension of the width of each of the cut magnetic recording media adjusted to a prescribed with.

Thus cut magnetic recording medium does not cause cracks in the magnetic layer 12 and thus provides a smooth cut end. In addition, cutting of the hard magnetic layer 12 is carried out by means of the laser beam L, while the cutter is used for simply cutting the relatively soft substrate 11. This reduces abrasion of the cutter to lengthen its life.

Next, an example of a cutting apparatus for carrying out the present invention will be explained by using Fig. 1.

The cutting apparatus is one which cuts off the magnetic recording medium 1 with the magnetic layer formed on the substrate according to the method of the present invention while moving the magnetic recording medium 1 in the direction of an arrow A in Fig. 1 to provide magnetic tapes 1a, 1a ... each having a prescribed width. Namely, on the magnetic recording medium 1, a plurality of lenses 2, 2 ... for focusing the laser beam

L are disposed in parallel at prescribed intervals. Ahead of the lenses 2, 2 ... in the moving direction A of the magnetic recording medium 1, a plurality of cutters 4, 4 ... are disposed in parallel so that they are at intervals approximately the same as those of the lenses 2, 2 .... Consequently, while moving the magnetic recording medium 1 at a prescribed speed in the direction of A, the magnetic recording medium 1 is irradiated with the laser beams L, L ..., whereby the magnetic layer is cut off. Furthermore, by cutting the magnetic recording medium 1 along the cut magnetic layers, the magnetic tapes 1a, 1a ..., each having a specified width, can be obtained.

FIG. 3

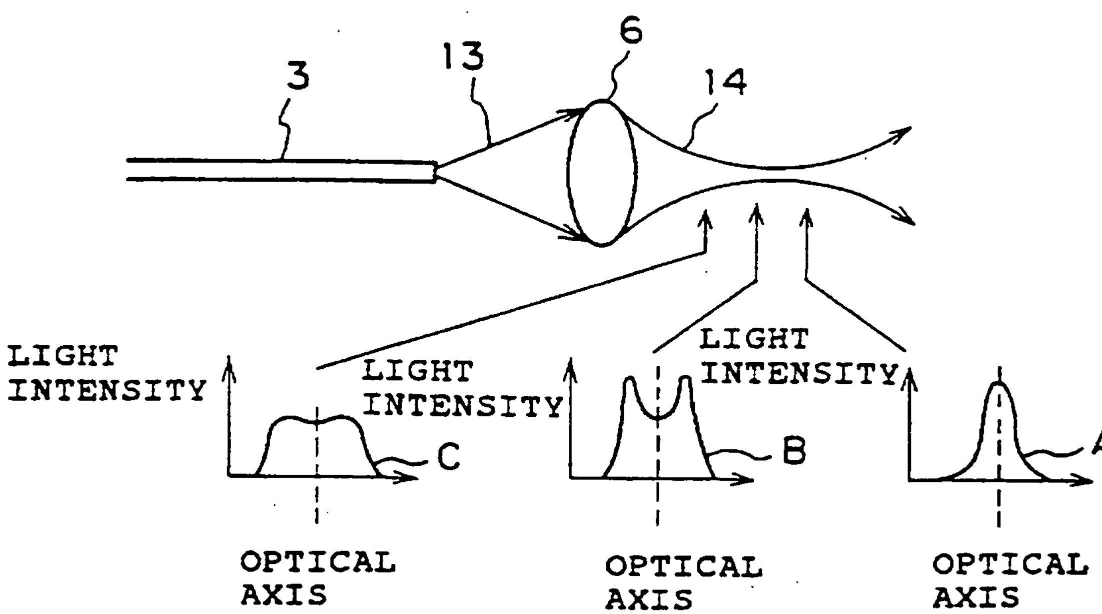

3
13
6
14
LIGHT
INTENSITY
C
OPTICAL
AXIS
LIGHT
INTENSITY
B
OPTICAL
AXIS
LIGHT
INTENSITY
A
OPTICAL
AXIS

FIG. 4(a)

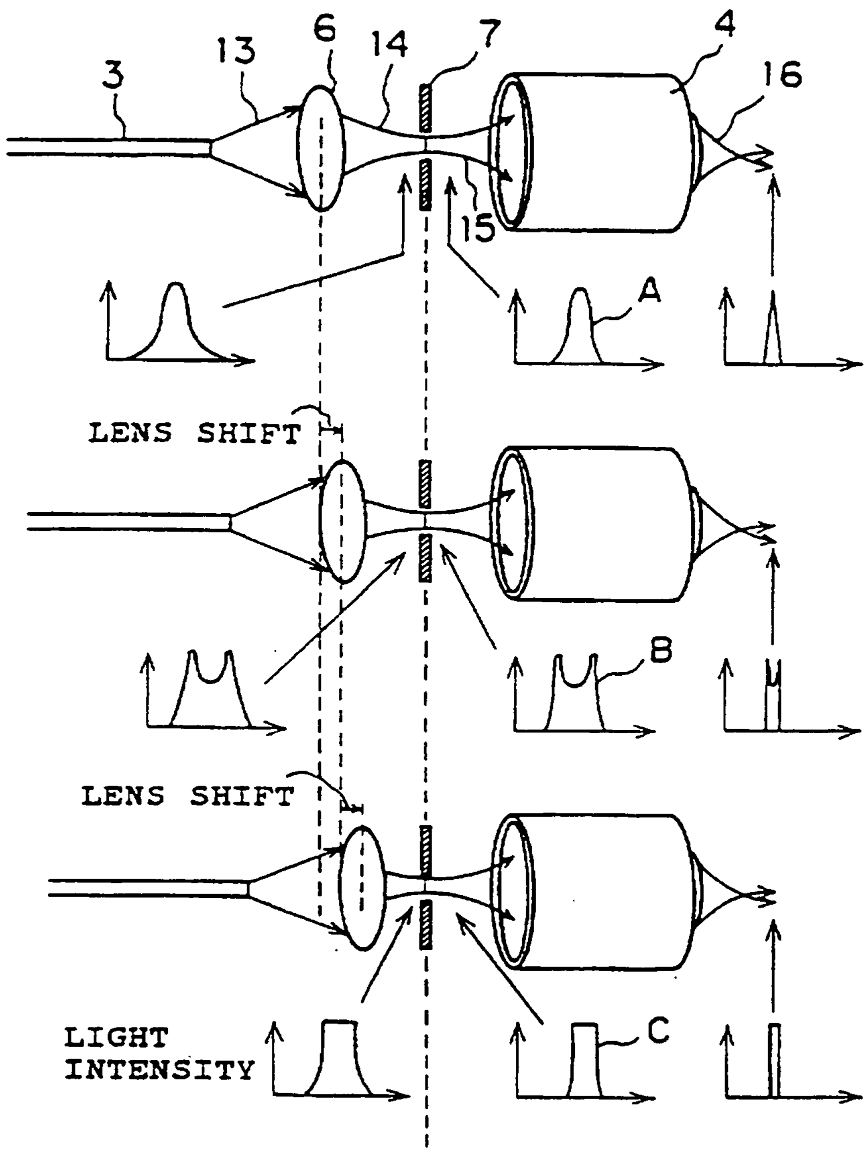


FIG. 4(b)

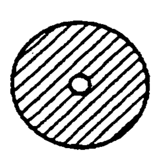


FIG. 11

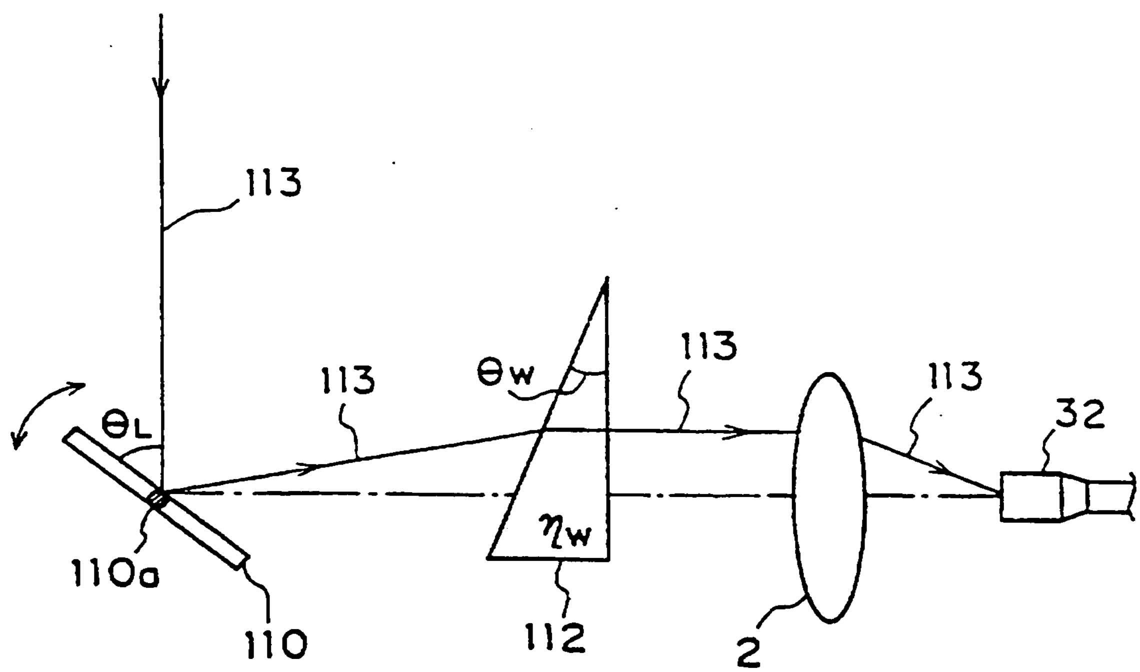


FIG. 9

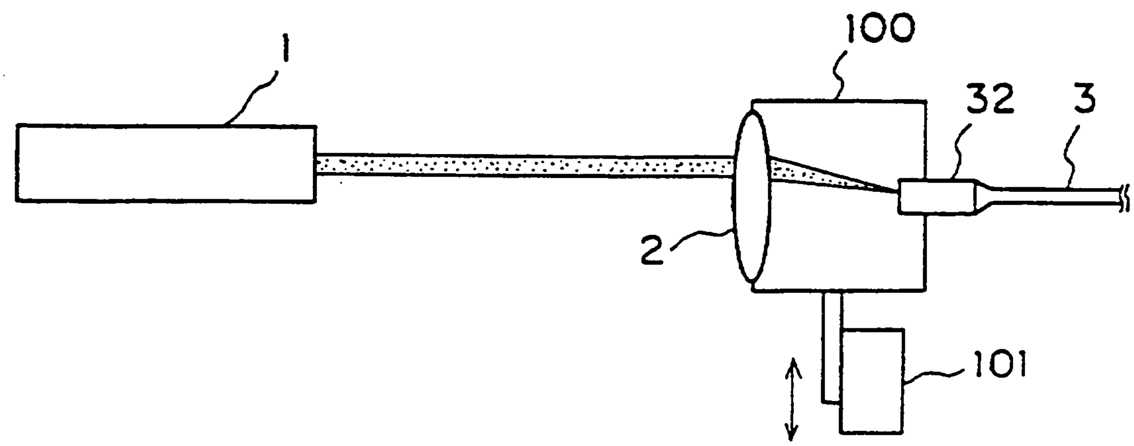


FIG. 10

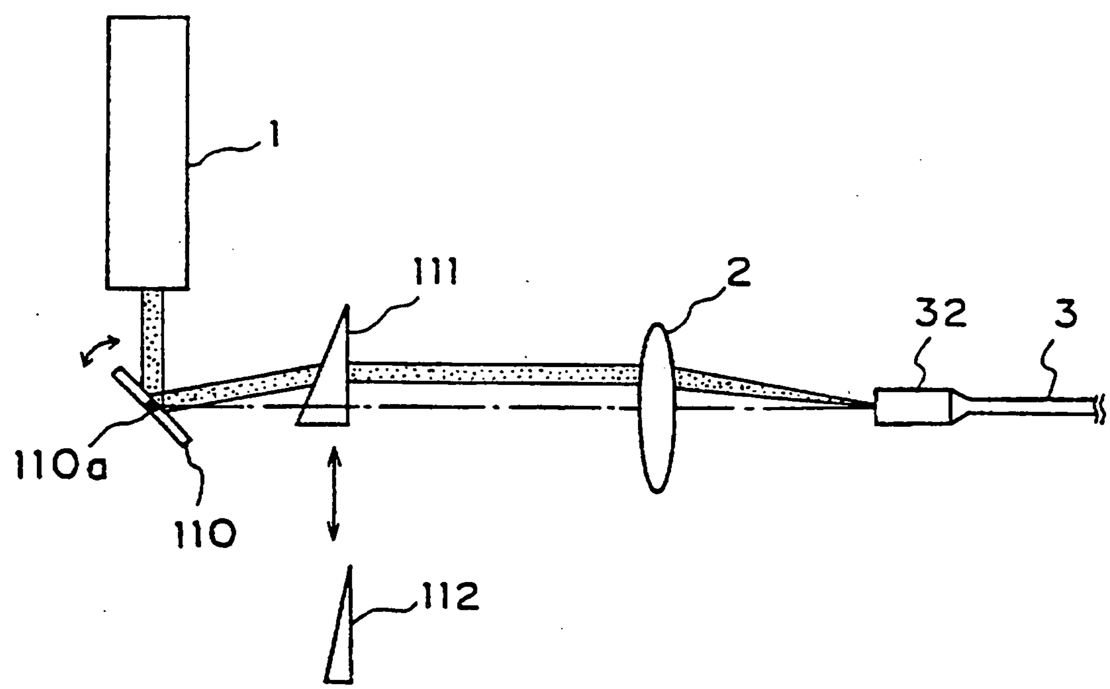


FIG. 7

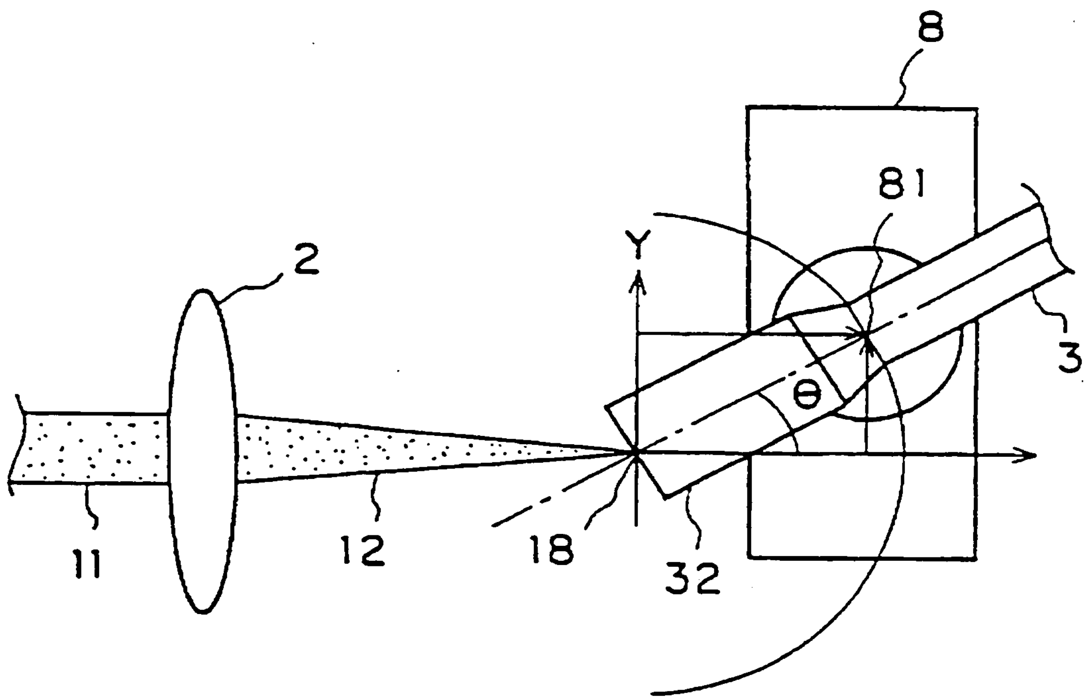


FIG. 8(a)

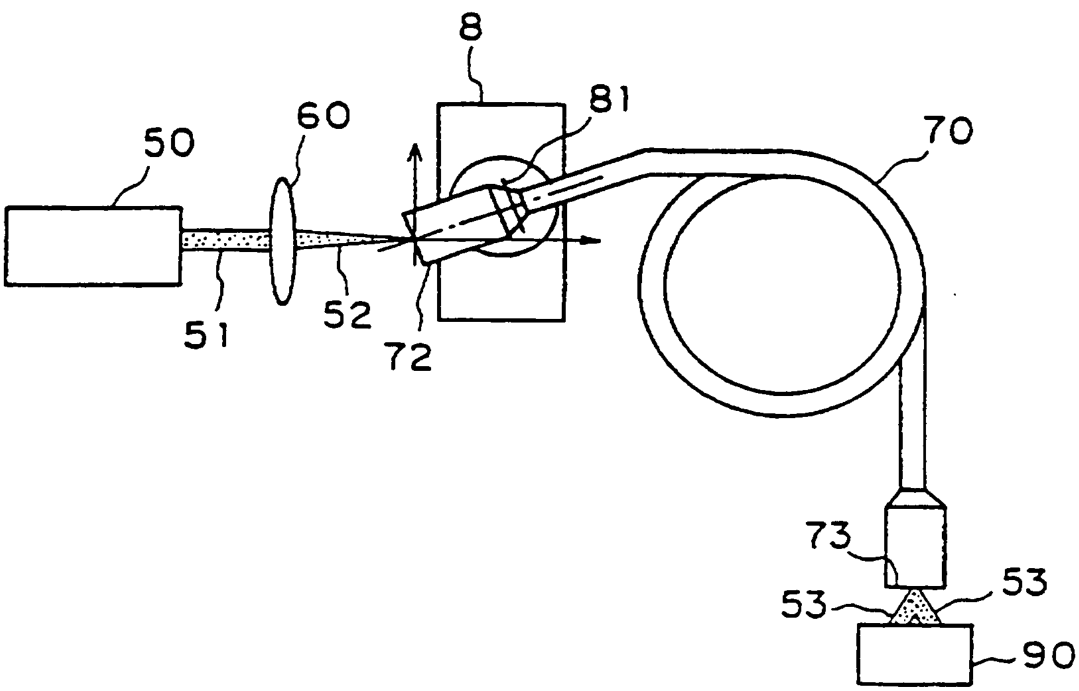
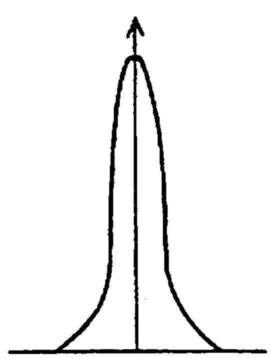
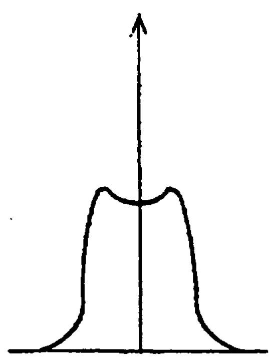


FIG. 8(b)



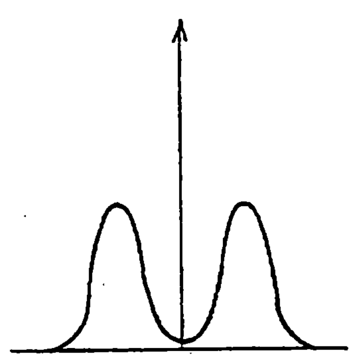
θ = 0°

FIG. 8(c)



θ = 5°

FIG. 8(d)



θ = 10°

FIG. 14(a)

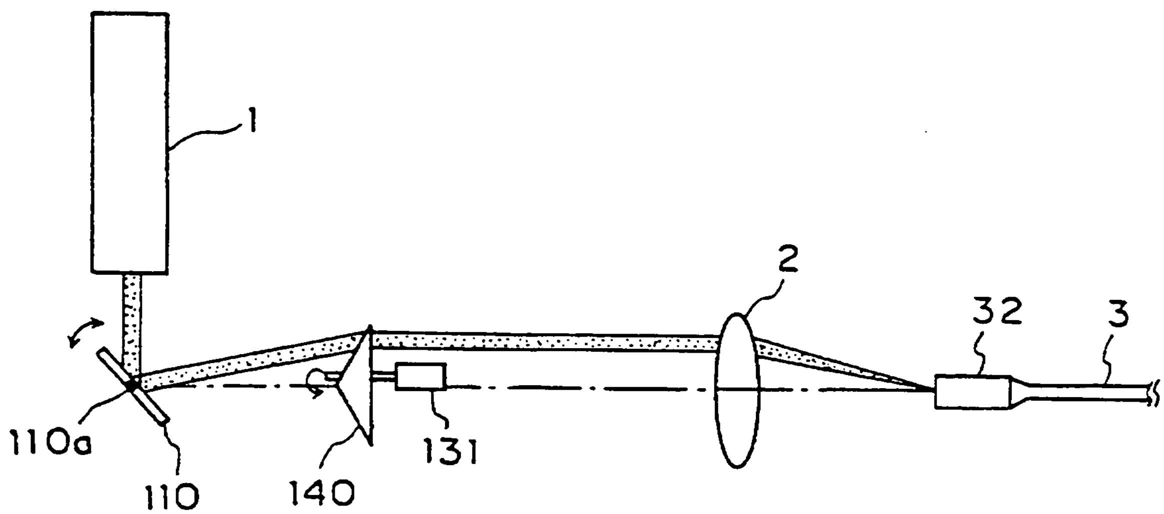


FIG. 14(b)

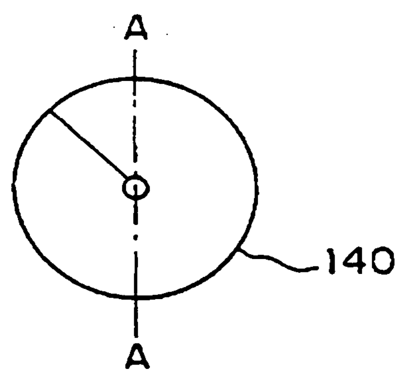


FIG. 14(c)

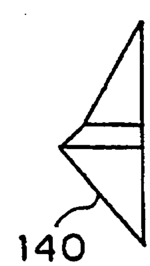


FIG. 15

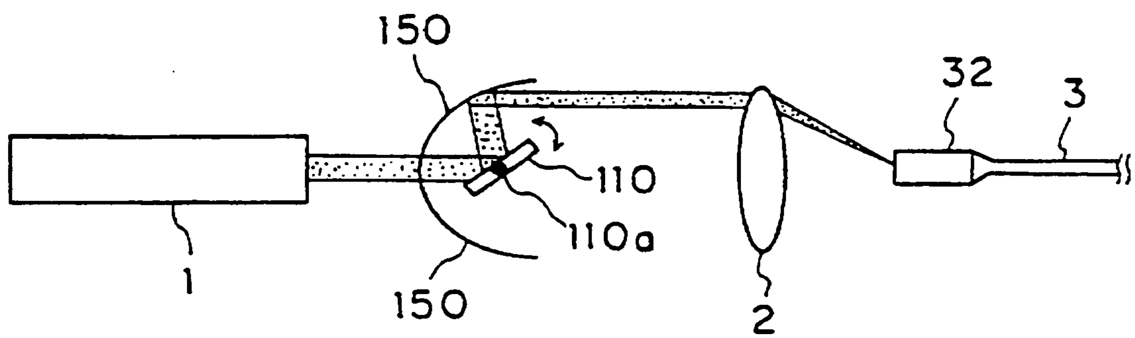


FIG. 16

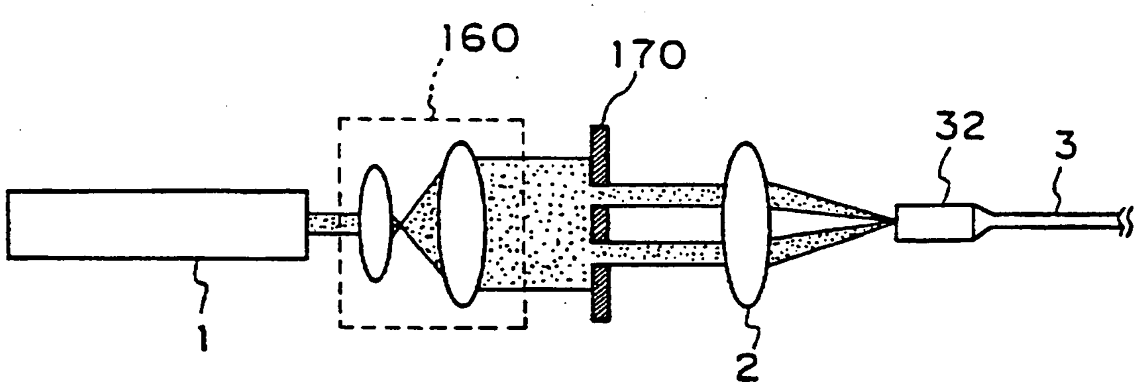


FIG. 12(a)

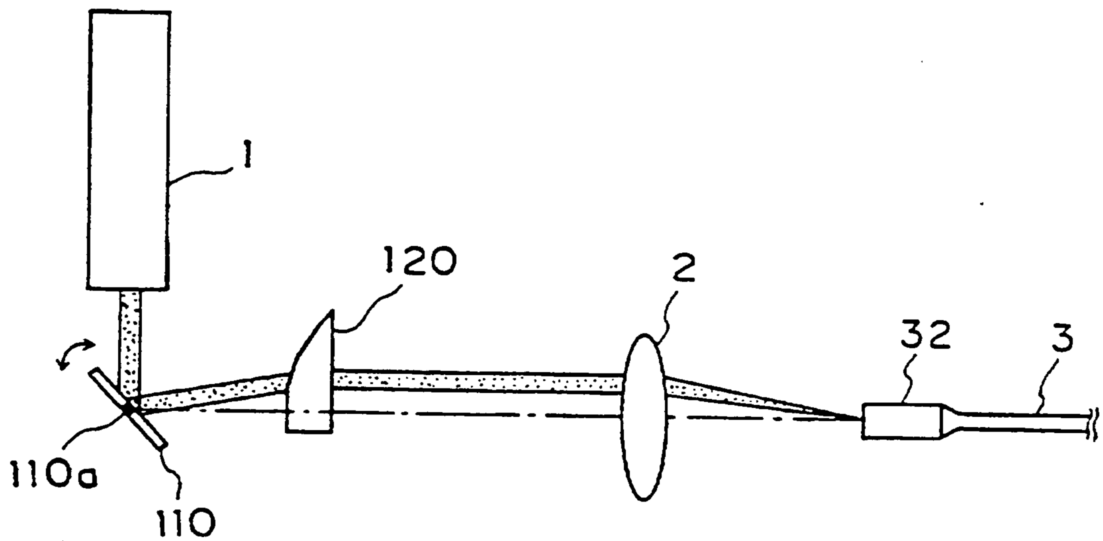


FIG. 12(b)

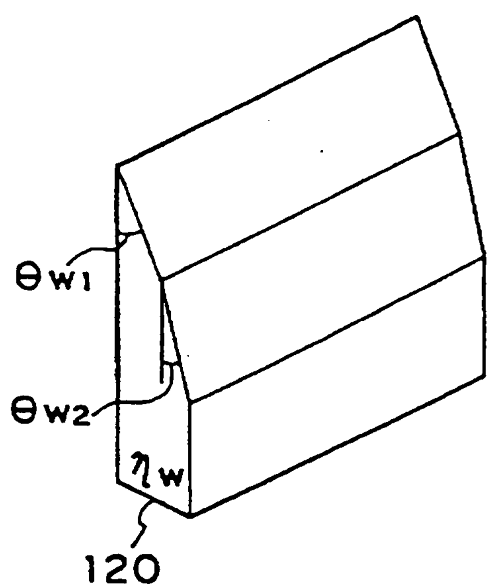


FIG. 13(a)

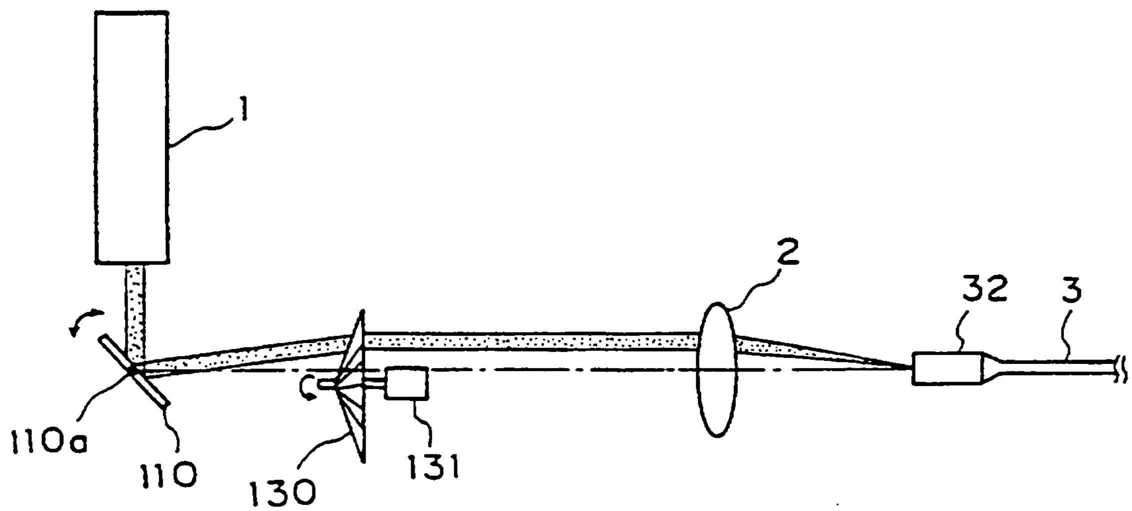


FIG. 13(b)

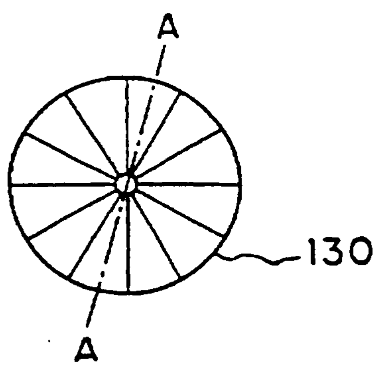


FIG. 13(c)